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High Power Radio Frequency (HPRF) Phase 2 Study

12

Meeting #6 Minutes (U)

16 September 1993

Captain William A. Lamb

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ROGER F. KROPF, Lt Col, USAF
Chief, Nuclear Advanced Concepts Branch

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High Power Radio Frequency (HPRF) Phase 2 Study

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(U) ACKNOWLEDGMENTS

(U) I would like to take this opportunity to thank Dr. James Hogan of Sandia National Laboratories, California who hosted the sixth meeting of the Joint DOE/DOD Phase 2 Feasibility Study of an HPRF device. His efforts along with the efforts of Mr. Kenneth Buck and Mr. Scott Faas prior to and during the meeting helped immensely and were appreciated by all in attendance.

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(U) INTRODUCTION

(U) The Nuclear Advanced Concepts Branch of the Nuclear Weapons Integration Division (SA-ALC NWI (AFMC)) conducted meeting #6 of the Joint DOD/DOE Feasibility Study of a High Power Radio Frequency (HPRF) Device on 14-16 September, 1993. The meeting was held at Sandia National Laboratories (CA) in Livermore, California. The purpose of the meeting was to convene working groups, review working group progress, and update the program status. Individual working groups met during the first two days of the meeting. A general session was held in the morning of the final day. The agenda for the general session is contained in appendix A.

(U) The former Nuclear Weapons Concept Division of the Office of Aerospace Studies has been integrated into the Nuclear Weapons Integration Division at Kirtland AFB, New Mexico. The only impact upon this study will be the name change, the new address, and the new phone numbers of the study director.

(U) These meeting minutes document meeting #6 and include copies of presentations from the working group meetings as well as the general meeting. Additionally, a list of attendees is provided in appendix B. The meeting highlights are presented in the following sections.

(U) The topics of discussion during the meeting dealt with the progress of the working groups, funding aspects of phase 2 work, information requirements and interchanges needed for the working groups.

(U) CLASSIFICATION AND SECURITY

[redacted] The study director, Capt Lamb, presented an overview of the classifications involved in the HPRF Phase 2 Study. Specifically, each individual involved in this study needs to be aware of the proper classification of the materials generated or produced. The classification guides for this study are listed inside the front cover of this report.

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[redacted] Information provided on the employment of such a device can also carry other caveats such as Not Releasable to Foreign Nationals (NOFORN) and Warning Notice - Intelligence Sources and Methods Involved (WNINTEL). Additionally, information concerning the nuclear design of the HPRF device most likely contains Critical Nuclear Weapon Design Information (CNWDI). It is imperative that all information that is classified be afforded the proper classification security protection. If there is any doubt as to the classification of any information, please take the time to investigate the classification guides or ask the proper knowledgeable individual. A request for information about classified material requires a need-to-know before access to the information can be provided. Make sure you have properly identified an individual's need to know. In regards to unclassified material associated with this program, please handle the information with care. Proper operation security (OPSEC) requires that the unclassified material not be released that can give uncleared individuals enough information to piece together classified information.

(U) SURETY WORKING GROUP

[redacted] The SWG report for meeting #6 is included in appendix C. The working group has continued to evaluate the operational safety and nuclear safety use control issues. The House of Quality (HOQ) and the PUGH matrix are being used to evaluate the proposed design candidates and preliminary evaluations presented. In the use control area, work is continuing to identify the implementation options. Mr. William Barry presented details of the Failsafe and Risk Reduction study (FARR). Other discussion from the working group centered around the work in analyzing the warhead candidates.

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(U) SYSTEM ENGINEERING WORKING GROUP

[redacted] These inputs are provided as appendix D. The SEWG reviewed the New Mexico design concepts and the California design concepts. A review of the baseline designs and the variables for the designs were discussed. Further analysis of the flight calculations are required to provide the confidence levels desired. The availability of hardware for the HPRF program was discussed.

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(U) REQUIREMENTS WORKING GROUP

[redacted] The Requirements Working Group (RWG) met during the first day of the working group meetings. The meeting minutes are included in appendix E.

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The working group reviewed the action items from their previous meeting and discussed the requirements for inputs from other working groups. The working group planned to review the Military Characteristics (MCs) during the working group meeting but the material was not available so discussion centered on the future work by the group. An MC review meeting will be held in November after the members have a chance to review the current MCs with results reported back during the December HPRF meeting. Additionally, the Stockpile-to-Target Sequence document will be reviewed beginning in early 1994.

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SEPT. 22, 1993

DRAFT

**Preliminary
Nuclear Safety Assessment of
HPRF Warhead Candidates**

1. Methodology

Each of the warhead candidates will be evaluated based upon eight criteria that were agreed upon by the nuclear safety assessment team. These attributes are intended to address only nuclear detonation safety. It is assumed that all candidates will be inherently one-point-safe and employ a TATB based insensitive high explosive (IHE). IHE is relevant to nuclear detonation safety only in that it decreases the likelihood of a multi-point initiation by means other than initiation of the main detonators. Each of the weapon candidates is evaluated against each criterion and given a rating between -2 and +2. The resultant matrix is the Pugh Matrix used in the QFD process.

2. Evaluation Criteria

2.1 Resistance to Direct Multipoint Initiation

If the physics package is one point safe, as has been assumed here, the only way in which a nuclear detonation can be achieved is by initiating the main charge explosive at more than a single point. This may be either at multiple discrete points or along a line or surface. What we are looking for here paths other than the intended modes through the detonators. The critical consideration is the overall integrity of the exclusion region, and especially, lack of penetrations into it.

2.2 Insensitivity of Detonators

Main charge detonators can be grouped into three broad categories, based on sensitivity, exploding bridge wires (EBWs), electrical slappers, and direct optically initiated (DOI) slapper detonators. EBWs and electrical slappers require a rapidly rising, high voltage pulse for activation. The required pulse is rather unique as far as abnormal environments go. Weapon firesets, however, are an ever present source of such a pulse. Lightning is another source. The electrical slapper detonator requires a higher peak current and faster rise time than does an EBW and can thereby be considered less sensitive. It was assumed, however, that all candidates except DOI would employ electrical slappers. The baseline W78 was rated lower because it uses EBWs. The DOI detonators are said to be extremely insensitive to any stimulus other than the laser produced light source of the fireset. This concept was therefore rated high in this category. It must be kept in mind, however, that the claims of insensitivity still need to be verified.

2.3 Exclusion Region Thermal Robustness

This attribute is a measure of the ability of the exclusion region to maintain integrity and provide isolation during or following exposure to high temperatures. The key feature

3.2 Insensitivity of Detonators

The main charge detonators for this design are electric slappers, which is judged adequate but not exceptional, so a rating of 0 is given.

3.3 Exclusion Region Thermal Robustness

The fireset is made from stainless steel having excellent high temperature properties. The aluminum primary can has a relatively low melting temperature, but if that can should melt, the high explosive will likely be hot enough to decompose or burn preventing nuclear detonation. An assessment rating of +2 is given.

3.4 Exclusion Region Mechanical Robustness

The fireset is a sturdy design of high strength material. Mounting of the stronglinks appears quite solid. The taped joint between the fireset and the primary can is strong. It is highly recommended that the warhead trigger signal be passed into the fireset through the stronglink eliminating the penetrations necessitated by the plasmatron. An assessment rating of +2 is given.

3.5 Discrimination level of the stronglinks

Each of the stronglinks in the Dual Stronglink Assembly (DSA) has acceptable discrimination of a well designed, 24 event, unique signal so a rating of +2 is given. It should be pointed out, however, that the present and currently envisioned future warhead/missile interface can supply only a single unique signal. This may necessitate providing a unique signal generator (USG) within the warhead. A high level of safety is difficult, but possible to achieve in a ballistic missile USG.

3.6 Stronglink Resistance to Bypass

The magnetic stronglinks are very resistant to high voltage arc over. The strong mounting arrangement minimizes the likelihood that they may be torn away. As stated above, sending the trigger signal through the stronglink is recommended. A rating of +2 is given.

3.7 Stronglink Location

The stronglinks are mounted on the fireset rather than the detonators so a rating of +1 is given.

3.8 Weaklinks

The weaklink that is designated to fail prior to the failure of the stronglinks in thermal environments is the fireset capacitor. This is believed to be only moderately effective. It has mylar dielectric, but it is mounted inside a can that insulates it from external environments. Tests have shown that for certain "smart" fires, the capacitor may not fail before the stronglinks. There is no mechanical weaklink identified for the system. The robust fireset and attachment alleviate this concern to some extent. This candidate is rated 0 in this category.

3.9 Total

The total rating score is +11

4. Evaluation of NM Candidate #2

New Mexico candidate #2 is said to be structurally very similar to candidate #1. The main difference is that one of the dual magnetic stronglinks is replaced by a Detonating Safing Stronglink (DSSL). This assessment is very tentative since the design is only conceptual. Since it is similar to candidate #1, I will address only those areas in which there are differences.

4.1 Resistance to Multipoint Ignition

The existence of the DSSL and associated actuator and monitor cables provide potential paths for introducing energy to the physics package, therefore this design is not seen as resistant to this threat as the first candidate. Rating is +1

4.2 Insensitivity of detonators

The detonators in this design are protected by a stronglink, so even though they are not inherently less sensitive, they could be given additional credit in this category to +1.

4.3 Exclusion Region Thermal Robustness

See section 3.3, rating +2.

4.4 Exclusion Region Mechanical Robustness

In general this design should yield a mechanically robust exclusion region, but it is believed that the penetrations required by the DSSL cables will degrade this attribute some to a +1.

4.5 Discrimination level of the stronglinks

Each of the stronglinks, the SSA and the DSSL has acceptable discrimination of a well designed, 24 event, unique signal so a rating of +2 is given. It should be pointed out, however, that the present and currently envisioned future warhead/missile interface can supply only a single unique signal. This may necessitate providing a unique signal generator (USG) within the warhead. A high level of safety is difficult, but possible to achieve in a ballistic missile USG.

4.6 Stronglink Resistance to Bypass

The DSSL has the advantage that is location near the physics package offers little room for bypass. Because, however, it requires bringing actuator and monitoring cables up to the physics package, it may provide its own path for bypass. A raring of +1 is given.

4.7 Stronglink Location

This is the area where the DSSL shines. It is located near the physics package, so that if the fireset or other part of the exclusion region has been penetrated, the stronglink may still provide protection. Rating is +2.

4.8 Weaklinks

[redacted] Both are good, first principle weaklinks. A feature that needs to be evaluated is the collocation of the capacitor and the SSA. For now, a tentative rating of +1 is given.

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4.9 Total

The total rating score is +11.

5. Evaluation of New Mexico Candidate #3

New Mexico candidate #3 is said to be structurally very similar to candidate #1. The main difference is that one of the dual magnetic stronglinks is replaced by an Inertial Piston Accelerometer Stronglink. This assessment is very tentative since the design is only conceptual. Since it is similar to candidate #1, I will address only those areas in which there are differences.

5.1 Resistance to Multipoint Initiation

This candidate is seen as equivalent to candidate #1 in this category. Rating is +2.

5.2 Insensitivity of Detonators

This candidate is seen as equivalent to candidate #1 in this category. Rating is 0.

5.3 Exclusion Region Thermal Robustness

This candidate is seen as equivalent to candidate #1 in this category. Rating is +2.

MINUTES

HIGH POWER RADIO FREQUENCY
REQUIREMENTS WORKING GROUP MEETING 93-3

14 SEPTEMBER 1993

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APPENDIX F

(U) WARHEAD DESIGN WORKING GROUP

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